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Temporal lobe surgery for intractable epilepsy in children: What to do with the hippocampus?

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ABSTRACT

Purpose: Resection of the hippocampus can cause verbal memory decline, especially in the pediatric population. Thus, preservation of the hippocampus can be crucial for the quality of life of children with intractable temporal lobe epilepsy (TLE) who are candidates for epilepsy surgery. We investigated techniques that determine whether the hippocampus is part of the epileptogenic zone and the outcomes of pediatric surgery aimed to spare the hippocampus.
Methods: We accessed data of children with normal hippocampus on MRI, who underwent surgery for medically refractory TLE. To identify epileptogenic areas, electrocorticography was performed in patients with space occupying lesions adjacent to the hippocampus, and long term invasive monitoring in patients with nonlesional TLE. Postoperative seizure control was classified according to Engel I-IV; Class I indicates seizure-free.
Results: Eleven females and 11 males met study inclusion criteria; the mean age at surgery was 11.3 years. Cortical and hippocampal electrocorticography was performed in 15 patients and long term invasive hippocampal monitoring in seven. The hippocampus was preserved in 16 patients (73%) while hippocampectomy was performed in 6 (27%). At the end of a mean follow-up of 3.5 years, 94% (15/16) of the patients who did not undergo hippocampectomy were classified as Engel I, compared to 50% (3/6) who underwent hippocampectomy.
Conclusion: Sparing the hippocampus in temporal lobe epilepsy surgery is possible with excellent seizure outcome, while using the proper intraoperative technique.

1. Introduction

Temporal lobe epilepsy (TLE) is the cause of medically intractable seizures in 8 to 20% of pediatric epilepsy cases [1,2]. Good seizure outcome, 2–5 years after temporal lobe surgery, was reported in 72–86% of patients [3–6]; yet outcome has been shown not to remain stable over time and to decline to 41–67% in follow-up of more than 10 years, both in children [6–8] and adults [9]. Three systematic reviews that analyzed mostly data of adult patients concluded that tailored surgery for lesional TLE that included the amygdala and hippocampus conferred better seizure outcomes than gross-total resection (GTR) alone [10–12]. Better epilepsy outcomes have been reported even when the hippocampus appeared normal in MRI studies [13] and when tumors did not invade the hippocampus [14]. In children, data are more sparse and less conclusive. Some pediatric studies have claimed better seizure outcomes following more extensive surgical resection [6,15–17]. However, no benefit in seizure outcomes was observed in a cohort of children who underwent tailored resection according to epileptogenicity compared to those who underwent GTR alone [18]. Moreover, unsatisfactory seizure results were reported in pediatric patients who underwent amygdalohippocampectomy

Abbreviations: TLE, temporal lobe epilepsy; GTR, gross-total resection; AH, amygdalohippocampectomy; ATL, anterior temporal lobectomy; DNET, dysembryoplastic neuroepithelial tumor.

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(AH) and left-sided surgery, compared to patients who had anterior temporal lobectomies and lesionectomy alone [4]. The above studies were retrospective, and did not generally account for the presence and location of lesions in relation to the hippocampus. When a lesion is cortically based and is not near the mesial structure, lesionectomy alone can achieve good seizure outcome, also in children [16]. When the lesion involves the hippocampus or when the mesial structures look abnormal in the MRI there is a clear indication to resect the hippocampus and amygdala in pediatric patients [19]. On the other hand, it is unclear whether the mesial temporal structures should be resected when the lesion is in close proximity to a hippocampus that appears normal on MRI. The role of hippocampectomy in nonlesional temporal lobe epilepsy is also unclear. Moreover, the potential effects of resection of the medial temporal lobe structures and the risk factors for postoperative verbal memory decline in children have not been extensively investigated. Skirrow et al. [20] recently reported that better verbal memory was linked to greater post-surgical residual hippocampal volumes, mainly in the left hemisphere [20].

The goal of temporal lobe epilepsy surgery is to resect the epileptogenic zone while preserving the functional areas, specifically the hippocampus. In this paper we aimed to assess the decision making process regarding resection of the hippocampus in children with intractable temporal lobe epilepsy and without a lesion in the hippocampus as per MRI. We expected that patients who did not undergo hippocampectomy would have noninferior seizure outcomes compared to patients who underwent hippocampectomy.

2. Methods

We reviewed the medical charts of all children (< age 18 years) who underwent temporal lobe surgery for drug resistant epilepsy by one surgeon (MB) in two departments of neurosurgery between January 2008 and December 2015. We included in the study patients with temporal lesions involving the gyri adjacent to the hippocampus and with normal hippocampal appearance on MRI. We also included patients with nonlesional epilepsy and normal MRI. To state explicitly, children with cortical based lesions that were distant from the hippocampus by at least one gyrus gap and children with mesial temporal sclerosis and any hippocampal abnormality as per MRI were excluded from the analysis. MRI showing a normal hippocampus, on both sides, was a study inclusion criterion, as was the availability of follow-up data for at least one year. We reviewed the medical records for demographic data, age at seizure onset, age at surgery, and postsurgical seizure types and frequency. We also recorded the preoperative electroencephalogram (EEG) and video EEG (VEEG), neuroimaging studies and functional investigations. The operative notes were reviewed for intraoperative complications, before and after resection electrocorticography (ECoG) and pathology of the temporal resections. All children were with medically refractory epilepsy, had undergone a comprehensive presurgical evaluation and had been previously evaluated by EEG. All patients had undergone prolonged VEEG monitoring and MRI in a mesial temporal sclerosis protocol. For some patients, fMRI scanning was used to determine cerebral dominance for language.

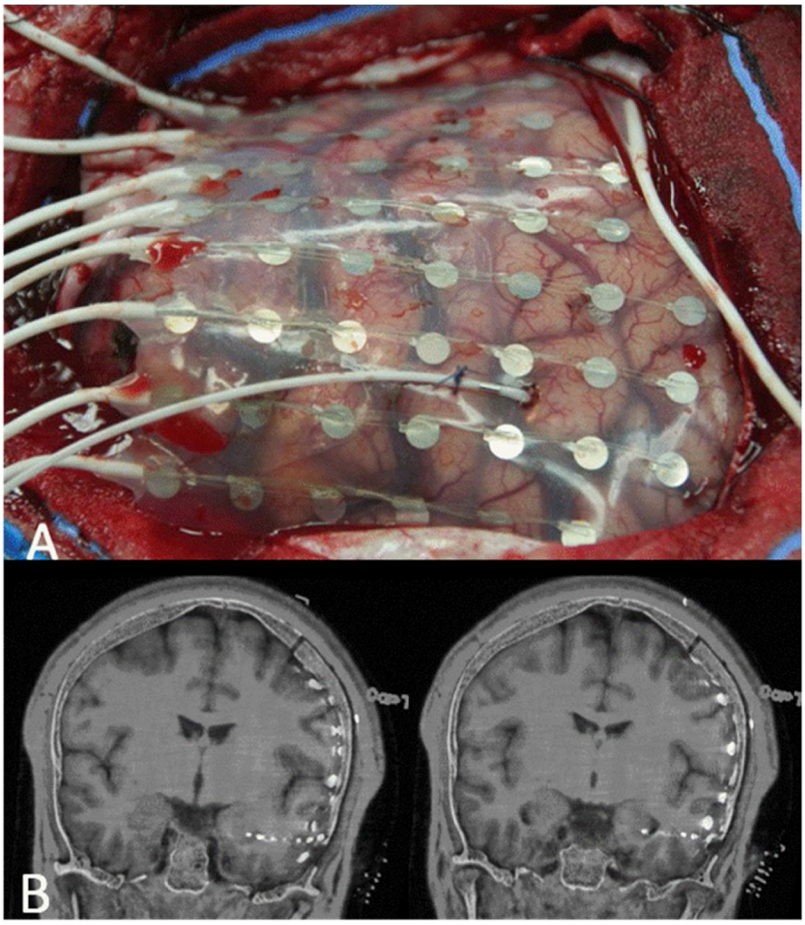

Fig. 1. Illustrative case of a patient (#1) with nonlesional left temporal lobe epilepsy. Subdural grid electrodes with strips and depth electrodes were implanted (A). The depth electrodes aimed to the anterior (left panel) and posterior (right panel) hippocampus, as demonstrated in coregistration of post implantation CT and preoperative MRI (B).